May 1991 A Cahners Publication

R&D

Research & Development

LABORATORY OF THE YEAR

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ABOUT THE COVER Researchers work inside *R&D's* Lab of the Year, the Genetics & Plant Biology Building at the Univ. of California, Berkeley. See story, page 50. *Photo: Russell Abraham.*

R&D

The International Magazine of Research and Development

R&D FOCUS

Laboratory of the Year 50
UC–Berkeley's Genetics & Plant Biology Building and three other research facilities win awards for outstanding design.

Near IR Opens a Window To Rapid Analysis 56
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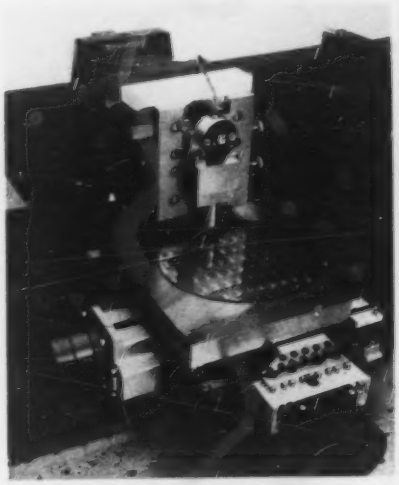
Improvements in lithography, optoelectronics, and nanostructure processes are shaping the next decade of microelectronics research.

Resurgence in Polymer Research Creates More Competition 76
New polymer alloys, blends, and thermoplastic composites introduced in the past year are now fighting for niche markets.



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Rx for Your Laboratory PC— A Good Dose of Maintenance 81
Often taken for granted, your laboratory computer system should be properly maintained to perform consistently at its best.

R&D BUSINESS

Researchers' Salaries Increase as Slow Drug Firm Growth Forces More Restructuring

The average industrial pharmaceutical scientist received a 3.4% salary increase in 1989 to $63,200, according to a recent survey by the American Association of Pharmaceutical Scientists, Alexandria, VA.

While the overall average increase failed to match 1989's 4.8% inflation rate, some individual statistics were more encouraging, such as the 15.9% increase to $44,500 for the starting salaries of pharmaceutical researchers right out of school and the 16.1% increase to $66,900 for researchers holding a PharmD degree.

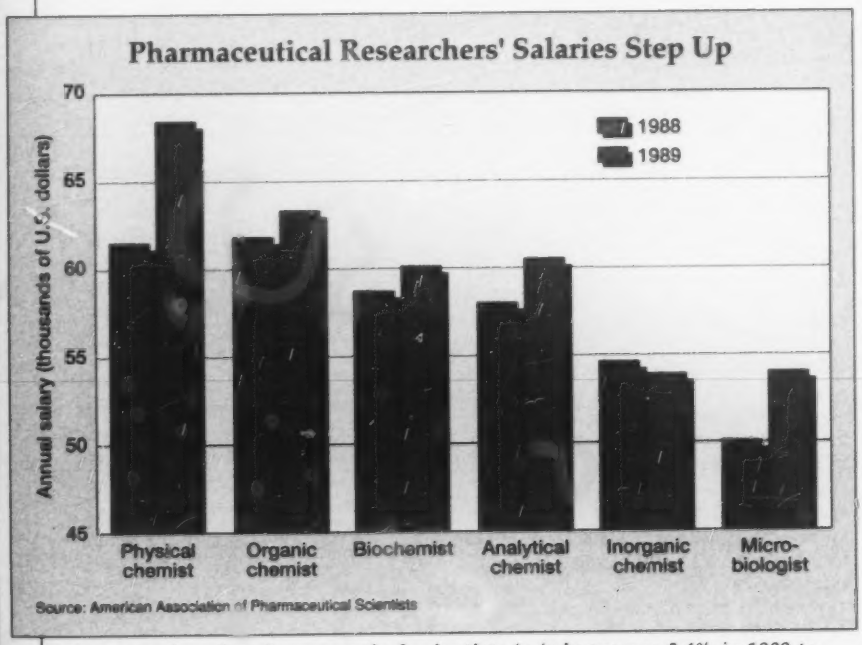
Industrial researchers received higher average salaries than those in colleges and universities ($58,800) and those in government laboratories ($54,400). Industrial researchers also received an average of $11,100 in supplemental income from their employers in 1989.

The salary increases for university (6.5%) and government (6%) pharmaceutical scientists exceeded those of their industrial counterparts. Restructuring of the pharmaceutical industry was at least partially responsible for holding down industrial increases.

"The pharmaceutical industry as a whole is strong," says Mason Irving, manager of Arthur D. Little's Health Care Practice. However, profits from existing drugs are slowing, with fewer new drug prospects in the pipeline.

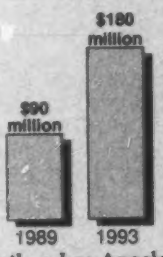
With slower revenue growth and increasing development costs, pharmaceutical firms are looking at new ways to develop drugs. In many cases, the bigger-is-better route is being taken, such as Merck's joint venture with DuPont in 1990.

In other cases, buyouts of biotech firms and large pharmaceutical firms are occurring to marry the best of both worlds, such as Roche's buyout of Genentech. "To be a major player in the pharmaceutical industry, your product line has to be liberally sprinkled with products from both the traditional sciences and biotechnology," says Irwin Lerner, president of Hoffman-La Roche, Nutley, NJ. □



Average salary for pharmaceutical scientists in industry rose 3.4% in 1989 to $63,200, $4,400 to $8,800 more than university and government scientists received.

Agriculture Driving Growth in Near IR



The market for near infrared (NIR) spectrophotometers is forecast to grow nearly 18% annually to $180 million in 1993, according to Strategic Directions Intl., a Los Angeles-based management consulting firm.

The most common applications for NIR instruments are in the agriculture and food industries. Its high growth is attributed to its efficiency and time-savings over LC and GC.

Israeli Government Offers Financial R&D Incentives

The Government of Israel is offering financial incentives to foreign investors in an effort to create jobs for the million Soviet immigrants expected in Israel over the next four years.

Approved ventures can receive up to 66% of the costs for an R&D project and the ability to depreciate 100% of the price of new equipment within one year. Investors also can obtain cash grants for up to 38% of the fixed asset costs, or government guarantees covering two-thirds of the total value of the investment.

For more information, call Govt. of Israel Investment Authority, New York 212/560-0630. □

Bilingual Demand Rising for Graduates

Companies are increasingly looking for—and finding—graduating technical professionals who are bilingual, according to Howard Wakeland, associate dean of the college of engineering at the Univ. of Illinois, Urbana.

"About a quarter of the companies that interview our students are looking for international characteristics, as

well as a strong engineering background," he says. "And they're finding good candidates because most of the better technical schools are enrolling students that have had two to four years of high school languages.

"The number of students taking a foreign language in our school has increased fourfold in the past 10 years," says Wakeland. "About 40% of our graduates have a reasonable capability in a second language."

Foreign companies also are interested in bilingual students, according to Wakeland. Japanese firms have shown an interest in U.S. graduates that could work in Japan for a length of time and then come back and manage a Japanese-owned production facility in the U.S. □

Recession Hurts Growth of Advanced Composite Materials

The current recession has hurt many industries that use advanced composite materials, especially construction, transportation, and marine industries, according to Patrick Moore, vice president of reinforcement materials, Owens-Corning Fiberglas, Toledo, OH. He forecasts a 3.7% decline in 1991 shipments from 1990 shipments, which were 3% lower than 1989 shipments.

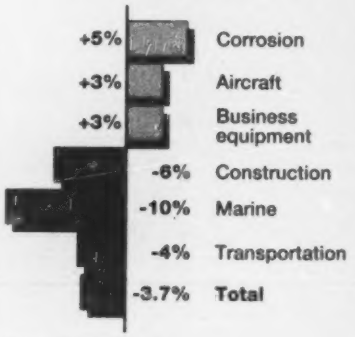
Moore bases this and other forecasts on a number of key indicators, including a 0.8% decrease in the Industrial Production Index for Manufacturing Durables, an 8.8% drop in new housing starts, a 4.2% decrease in auto production, 4.1% inflation, and 6.4% unemployment.

"We expect this slowdown to continue through most of 1991," Moore says. He also notes that the composites industry has consistently rebounded from previous recessions.

The economic slowdown is not slowing down the development of new composite products. "We are continuing to introduce new products that will work to open up new markets," says Moore. Owens-Corning expects to introduce new products for the corrosion, business equipment, construction, and automotive markets. Aircraft firms have a large backlog of orders, however, this is a relatively small market for fiberglass composites.

Recently passed U.S. Environmental Protection Agency regulations requiring the replacement of many existing storage systems will support new product development for the corrosion industry. Moore forecasts sales to the corrosion industry to increase 5% in 1991, following a 5% decline in 1990 from 1989 levels. **R&D**

Total Materials Usage To Slump in 1991



Source: Owens-Corning

***Small increases** in corrosion and aerospace markets for fiberglass-reinforced composites won't be enough to offset decreases in other big volume areas.*

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Improved Techniques May Boost Desalination

Interest in desalination techniques is heating up in the U.S. as drought-stricken areas of California and other regions struggle—and often fail—to maintain adequate supplies of potable water.

Costs for the processes are still relatively high but have been decreasing. R&D into new membrane systems for reverse osmosis (RO) should bring costs down even more.

An example is a type of membrane produced by a new thermal-inversion process developed at the Lawrence Berkeley (CA) Laboratory (LBL). The microporous anisotropic polymer membranes have very closely controlled pore sizes and porosity gradients, which make RO more efficient, LBL researchers say.

Unlike commercially available membranes, those formed by this process are said to have a unique open pore structure that offers the ability to perform RO at a high volume processing rate.

Tests are reported to show that the polymer working surface can be easily modified by reheating the surface and re-executing the appropriate temperature program on one face. A variety of polymers and solvents can be used in the process, researchers say.

Even more dramatic gains may result from R&D into ceramic membranes like those being studied by Marc Anderson's group at the Univ. of Wisconsin, Madison. The UWM approach deposits thin ceramic films with very small, carefully controlled pore sizes onto appropriate support structures.

Nanometer-sized particles are fused to form the membrane that may be either a pure form of ceramic or a mixture. Among the support materials being tested are sintered stainless steel, porous carbon, porous alumina tubing, glass beads, glass tubing, and glass capillary tubes.

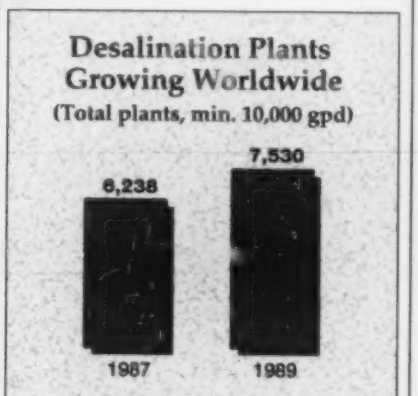
Ceramic membranes offer several advantages, according to Anderson.

"All membranes foul and must be cleaned with chlorine bleach, but that's hard on cellulose acetate membranes," he says. "Ceramic membranes are resistant to such chemicals.

"Also, the efficiency of RO goes up with pressure. Ceramics can take much higher pressures and temperatures without failing."

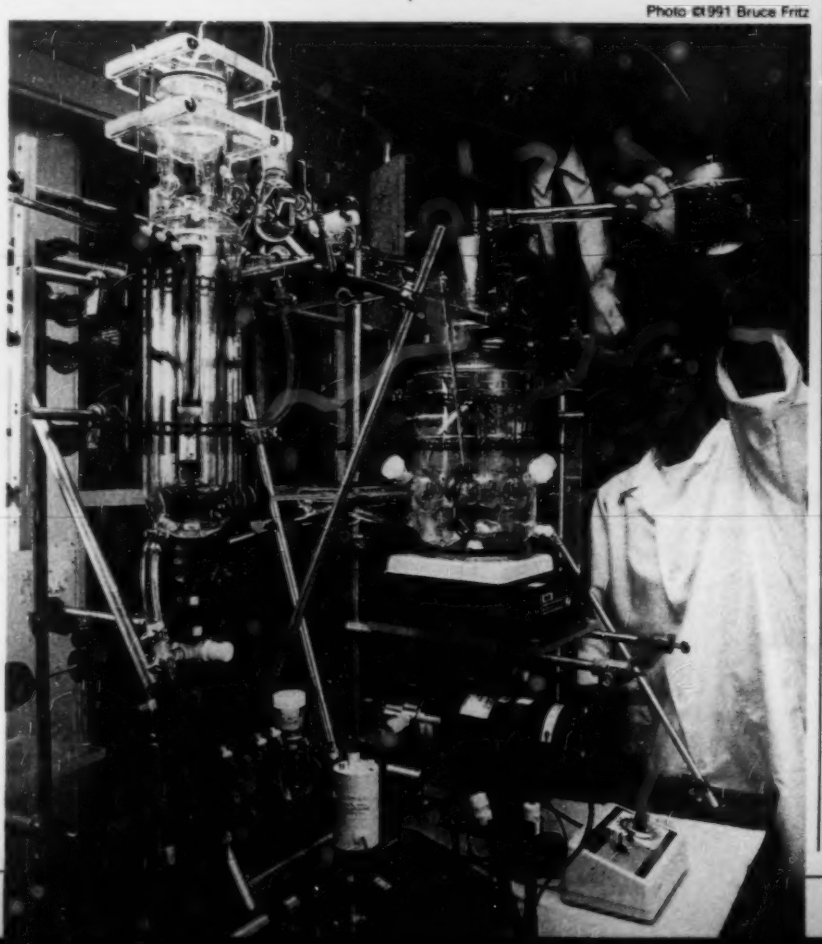
Organic membranes must be replaced every one to three years, but ceramics could provide an "almost unlimited lifetime," Anderson says.

"The prospects for ceramics are good. We're preparing microporous metal oxides with pore sizes below 10 Å. This will let us take a fresh look at desalination." □



***Desalination plants** averaged 9.9% annual growth in recent years and are still on the rise. The International Desalination Assn. expects major growth in California, Florida, and Middle Eastern nations.*

Photo ©1991 Bruce Fritz



***Ceramic membrane** research by the Univ. of Wisconsin, Madison's Marc Anderson (left) and research associate Jean-Pierre Kottelat has many possible applications, including reverse osmosis for desalination.*

Entrepreneurs at Heart

Want to run your own shop? You have lots of company, according to our Career Satisfaction Survey.

By Elizabeth Dougherty, Contributing Editor, R&D Magazine

Want to quit your job and become your own boss? You're not alone.

Although 93% of the more than 4,000 researchers who responded to *R&D Magazine's* first Career Satisfaction Survey do not own their own companies, more than a third (35%) would prefer to work for themselves rather than their current employers—or anyone else.

Three percent of the respondents already own their own companies, while another 4% own their own companies but also work for others.

Of the researchers who do not own their businesses, 42% are content to work for their current employers, in contrast to 23% who would opt for new employers. Fully 35%, however, would prefer to work for themselves.

Many researchers who would prefer to work for themselves say their employers don't listen to their input, aren't interested in new ideas, and don't appreciate them.

"Upper management fails to listen and communicate with its employees," says an industrial engineer in his 30s working in Massachusetts.

In fact, 37% of the men who do not already own businesses say they would like to, vs. 18% of women.

"I find it frustrating that management is not willing to take an interest in new ideas," says one woman who would like to own her own business. A materials researcher in Ohio asks: "Why have a development department if the company has no interest in developing anything new?"

"The work is fun, but the rewards are insufficient," says T.V. Fingier, a senior engineer in League City, TX.

"Government projects and contractors are much too bureaucratic," says E.G. McKannan, a manager at Boeing, Huntsville, AL, who would rather own his own business. "They need more small businesses, small groups, and 'skunk-works.' "

A solid group of researchers in every income category, ranging from 34% to 37%, would rather own their own companies.

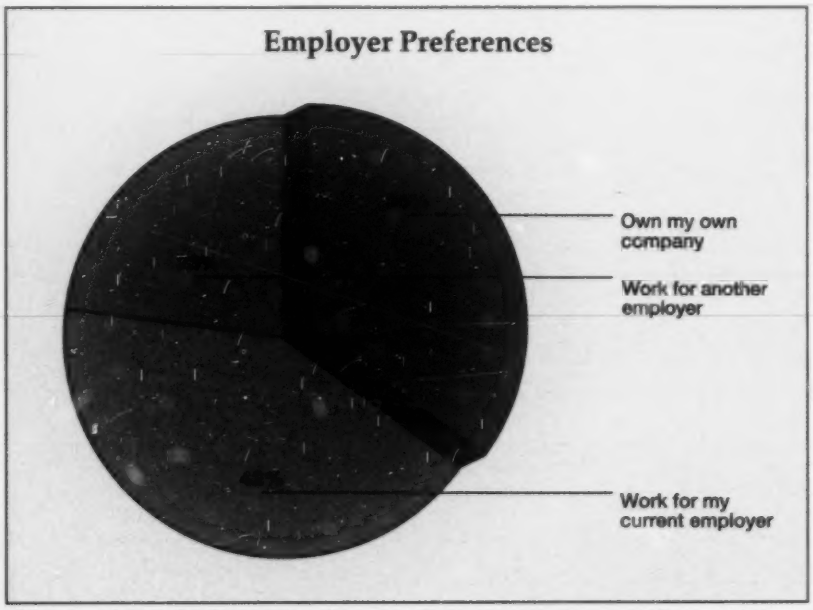
Approximately 36% of researchers under age 30 would prefer to own their own companies, as would 39% of those in their 30s. But from age 40 on up, the percentage of wishful entrepreneurs stabilizes at 33%.

Small entrepreneurial companies seem to attract employees who would like to make it on their own. The percentage of researchers who want to own their own companies is highest in organizations with fewer than 50 employees (45%). In organizations with 500 or more employees, only 33% want to strike out on their own.

Researchers with doctorates are the least likely to want to own their own businesses—only 30% would like to—while 40% of those with less than a bachelor's degree would like to do so.

Researchers who have fewer than 20 years' experience are most likely to desire owning their own companies. Of researchers with 5 to 14 years in their professions, 39% would like to do this, followed by 35% of those with 15 to 19 years' experience, and 34% of those with fewer than five years. At 20 years' experience and beyond, about a third of researchers who do not own their own businesses would like to.

Of researchers who have spent



Of researchers who do not already own their own companies, more than a third would prefer to run their own shops, R&D's *Career Satisfaction Survey shows.*

Getting the Job Is the Easy Part, Survey Shows

Getting a foot in the door is not a problem for most researchers. Employers often track them down. Fully 29% of respondents to our career survey were recruited.

Researchers also found jobs by word of mouth (20%), newspaper or journal ads (20%), sending unsolicited resumes (15%), internships or summer jobs (4%), and other ways, such as company takeovers (12%).

The percentage of researchers who were recruited by their employers went up with such factors as age, education level, experience, and salary level.

For example, only 22% of researchers younger than 30 were recruited, compared with 27% of those in their 30s, 31% in their 40s, 33% in their 50s, and 34% of those 60 or older.

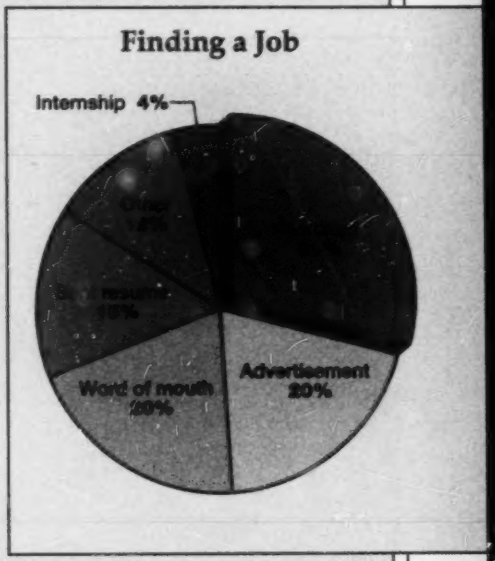
More than a third (37%) of researchers with doctorates were recruited, compared with 31% of researchers with master's degrees, 25% of those with bachelor's, and 21% of those with less than a bachelor's. Nearly a third of researchers with 15 or more years' experience were recruited.

Only 12% of those making between $20,000 and $29,999 were recruited. In contrast, employers recruited 44% of those making $70,000 or more.

Men (31%) are more likely to be recruited than women (20%). The percentage of researchers recruited in industry (32%) and universities (32%) is higher than that of researchers in government (24%) and consulting (22%).

Journal or newspaper ads were successful job routes for 24% of researchers younger than 40 and for 24% of female researchers. A quarter of the researchers with less than 15 years' experience found their jobs through ads.

Mid-sized companies successfully use advertisements to attract employees. The percentage of researchers working at organizations with 51 to 99 employees (27%) who found their jobs through ads edged out those who were recruited (26%).



Most researchers are recruited by their employers. Ads in newspapers and journals, word of mouth, and sending unsolicited resumes also have proved to be successful means of finding research jobs.

fewer than 15 years with their current employers, 38% would like to strike out on their own. This drops to 31% for researchers with 15 to 34 years' tenure and falls to 19% for those with 35 or more years' tenure.

Who actually takes the plunge? They're researchers like N.B. Proctor, a physicist who owns his own consulting firm in Texas.

"Being the owner is the only way to go in the U.S.A.," he says. "Big business and big government stifle productivity and innovation."

Of researchers who work solely for themselves, fully 60% are 50 years or older, 96% are male, 50% have 30 or more years' experience in their professions, and 69% have had four or more employers during their professional careers. More than half (57%) work in consulting, followed by 39% in industry.

Researchers with master's degrees or doctorates account for slightly more than half of the respondents who work solely for themselves.

Disciplines that attract company ownership include geology, industrial engineering, mathematics, and aerospace engineering. Less popular areas for self-ownership include chemistry, chemical engineering, and biology.

A third of self-employed researchers make $70,000 or more, 23% make between $50,000 and $69,999, 27% between $30,000 and $49,999, and 17% make $29,999 or less.

"Corporate America does not know how to utilize research and technology for profit in large organizations," says William Farone, owner of Applied Power Concepts, Tustin, CA. "Small companies appear to be the only current solution."

Working for yourself, however, is not always a bed of roses. While you gain independence, you often give up support services and work long hours alone solving problems.

Mi Aronson, an independent consultant based in Orlando, FL, lists low pay and poor benefits, inadequate facilities, and insufficient staff as the least satisfying aspects of his job.

Independent consultants suffer from a lack of stimulating interaction with colleagues, says R.J. Reilly, St. Paul, MN. "There's a danger of drinking your own bath water."

Four percent of respondents enjoy the best of both worlds—working for themselves and working for other employers. This group, too, is overwhelmingly male (97%).

More than half (52%) work primarily in industry, 17% in consulting, 15% in government, 11% at universities, and 5% in other categories.

Computers, industrial engineering, and geology are popular areas to combine jobs and company ownership, while chemistry and chemical engineering are the least popular.

Approximately 41% who combine self employment with other jobs make between $50,000 and $69,999; 38% make between $30,000 and $49,999; 15% make more than $70,000; and 6% make less than $29,999.

What do these results say about the entrepreneurial spirit of U.S. researchers—and what do they mean to high-technology companies?

For one thing, employers should not take the concerns of these budding entrepreneurs lightly. With loyalty to "the organization" on the wane and the supply of technical personnel diminishing, you could come up short of good people.

Most important, be aware that one out of three of the researchers in your laboratory is a budding entrepreneur. Keep them happy, or tomorrow they could be your latest competition. **R&D**

Please fill out the second annual R&D Magazine *Career Satisfaction Survey, located elsewhere in this issue.*

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Please rate your interest in this article by circling the appropriate number on the Reader Service Card.

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Laboratory Stirrers

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LIGHTNIN **Circle 271**

Data Analysis and Display

S-PLUS is an interactive computing environment that includes a full-featured graphical data analysis system and an advanced quantitative programming language. The program displays data and provides high-quality output for presentation and publication.
Statistical Sciences Inc. **Circle 272**

Full-Screen 'Paint' Program

The ColoRIX VGA Paint 1.3 program offers advanced full-screen and pixel-by-pixel editing. Files can be imported from or exported to all major desktop publishing, CAD, and presentation graphics programs.
RIX SoftWorks Inc. **Circle 274**

Workstation Image Analysis

Real Color Discrimination software enhances and segments images based on color for the company's VIDAS and IBAS workstations. It also measures color using an HLS (hue, luminance, saturation) color modeling scheme.
Carl Zeiss Inc. **Circle 275**

Mac Chemistry Graphics

ChemIntosh II is a drawing program designed to create publication-quality graphics for chemical reports and papers. The updated program adds 45 new features to the original version.
SoftShell International Ltd. **Circle 270**

Object Translation Code

An object translation code (OTC) is available now to bridge the gaps between DOS and UNIX and permit users to preserve their existing investment in programs and programming knowledge. The OTC runs as a stand-alone on the UNIX system.
TransWare Enterprises **Circle 276**

Circuit Troubleshooting

Version 6.0 of the Huntron Tracker 5100 DS electronics troubleshooting tool comes with 12 new features that enhance the user's ability to find circuit board problems. The new version also incorporates 19 significant program modifications.
Huntron Instruments Inc. **Circle 277**

High Tech Basic Upgraded

Complex numbers, loadable device drivers, high-resolution display support, international character support, and syntax extensions have been added to High Tech Basic release 3.0 for data transfer between HP workstations and DOS-based systems.
TransEra Corp. **Circle 278**

Security for PC/LANs

With Triumph! 2.0 installed on your networked PC, you can lock out unauthorized users, keep your data private, and analyze PC and software usage. The new release provides both increased security and faster log-on to the network.
Micronyx Inc. **Circle 279**

Chemistry Made Easier

Management of chemical reaction information has become easier with the release of REACCS version 8.0. This program assists in the compounding of chemical products, using proprietary databases to identify possible target molecules.
Molecular Design Ltd. **Circle 280**

ABP VBPA

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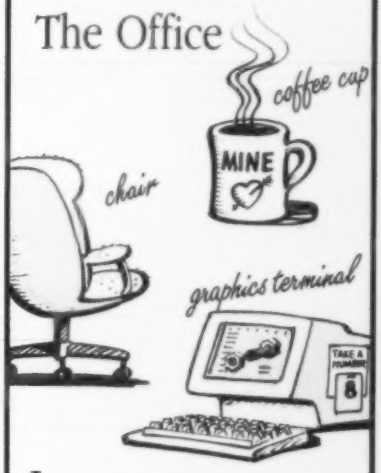
Three Things You Shouldn't Have To Share At The Office



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